# Status and plans of Coaxial Helicity Injection (CHI) Experiments in NSTX*

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# Status of CHI

- CHI produced 260kA toroidal current

- Obtained CHI injector current multiplication of 10 at 26kA

- Produced non-inductive, long pulse (200ms) discharges

- Sustained discharges at 1mTorr vessel neutral pressures. NSTX ohmic discharges operated at similar vessel neutral pressures.

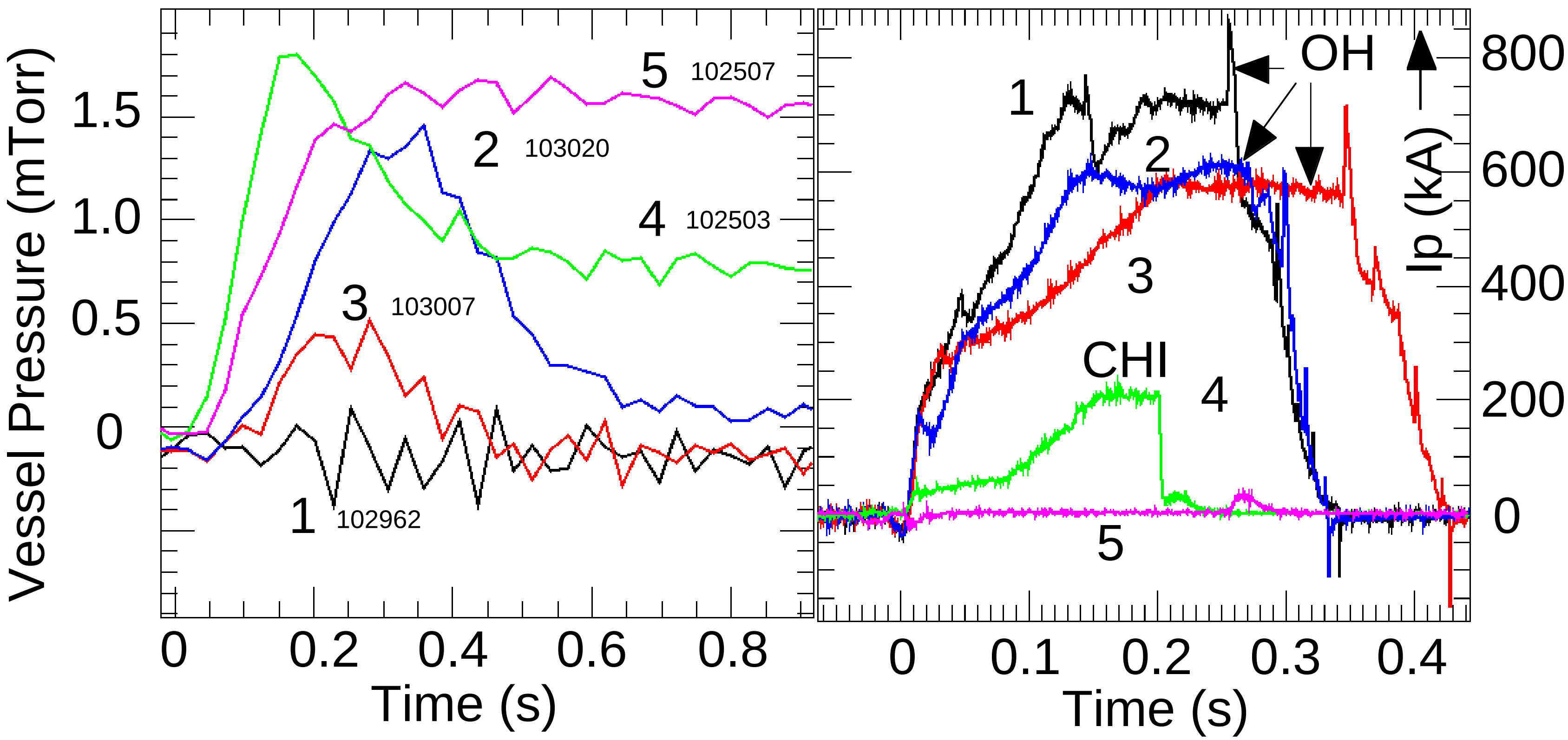
- There is no fundamental difficulty in applying CHI electrical systems to a large plasma device.

# Questions and recommendations from PAC-9

Summary of CHI startup results covering:

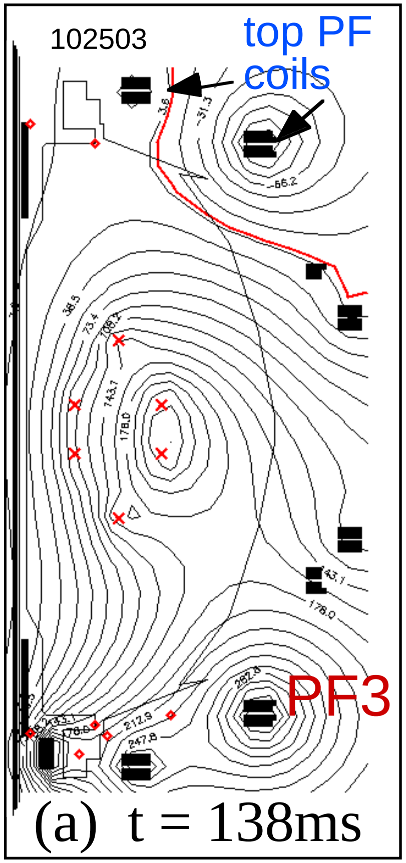
- Gas fill
- Plasma density, and electron temperature issues in forming toroidal current
- Use of inductive currents applied late in the discharge may also help to establish the CHI driven current in an equilibrium.
- Clarify goals of CHI target plasma for near-term and long term.

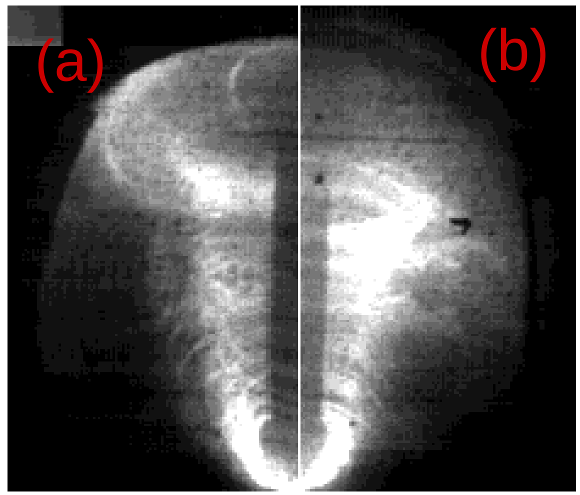
# CHI operated at vessel neutral pressures compatible with Ohmic operation



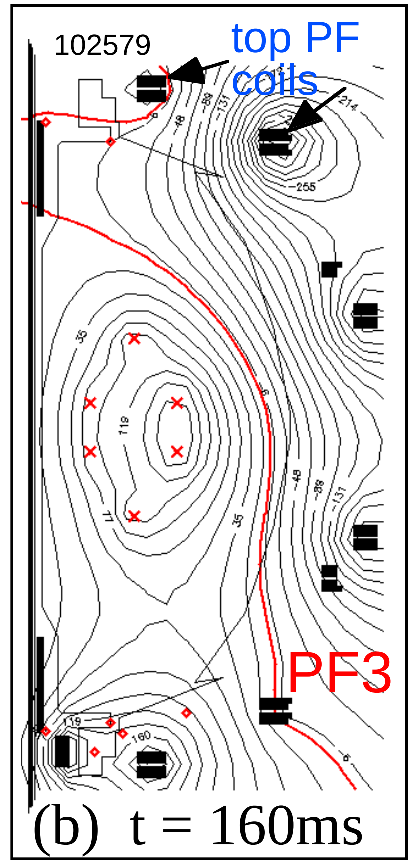
# Need to move CHI plasma core region to be in line of sight with Thomson for density and temperature measurement

High current configuration → Preferred configuration




- Reverse current in PF3
- Increase current in top PF coils
- Increase vertical field




Vacuum flux plots with <u>added</u> plasma current filaments (not EFIT)

# Near Term Goals (now to 9/02)

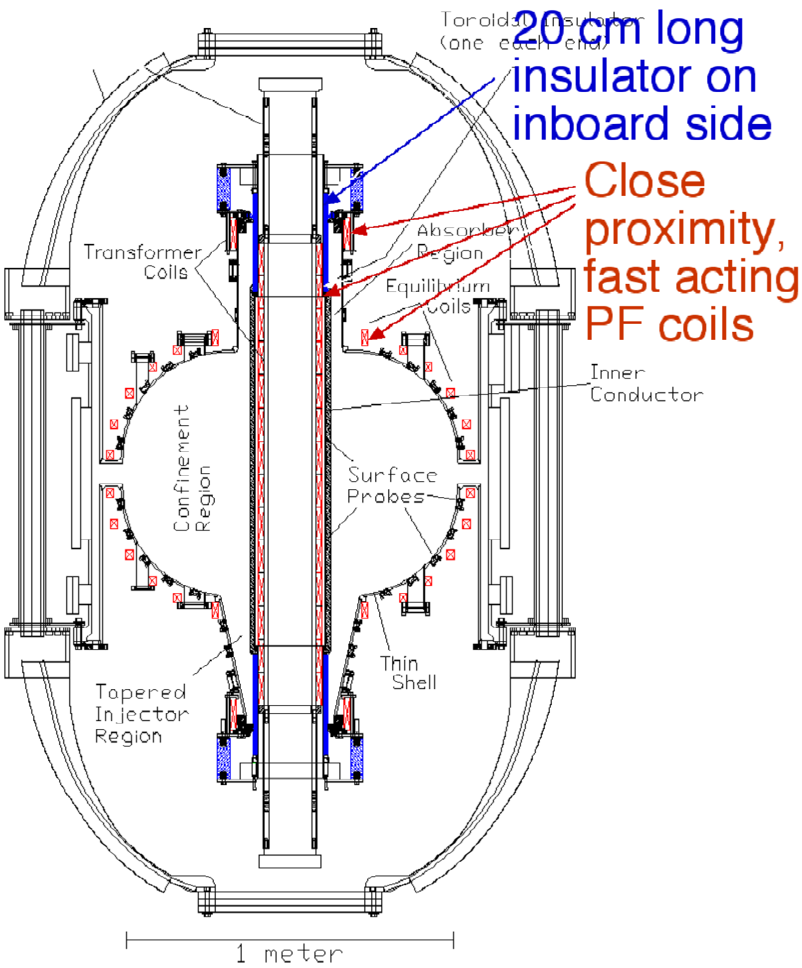
- Establish flux closure (may need good boundary shape control)
- Test OH induction on a high current CHI discharge
- Test CHI edge current on an OH discharge

- EFIT with open field line currents in private flux region
- Reduce absorber arcs
- Initiate feedback control tests

# Absorber arc suppression (D. Gates)

- PF1au to create absorber null
- Higher poloidal field in absorber
- Study options for additional field null control coils
- Redesign absorber insulator region
  - Insulator on high field side

# HIT-II absorber design allows good boundary shape control



# Add CHI to inductive plasma (D. Mueller)

- Can be run independent of arc problem
- Study CHI current drive and impact on transport
- Add auxiliary heating

# Demonstration of closed flux (R. Raman)

- Plasma shape control, absorber arc control, TF scan, gas puff scan, OH induction
- Peaked Thomson profiles + EFIT
- Modify EFIT to include private flux current (M. Schaffer, L. Lao)
- Measure poloidal (halo) current in injector region to constrain EFIT

# Begin feedback control development (B.A. Nelson)

- Absorber null control
  - Real-time null reconstruction technique
- Plasma current control
- Boundary control

- Note: CHI control requires conceptual development - not well formulated as with Ohmic plasma control

# Longer term goals

- Implement fast PF coils for absorber field reduction
- Redesign absorber (improved insulator and electrode shape)
- Establish plasma start-up without the OH coil
- Optimize CHI edge current drive on a OH target
- Reduce Ohmic flux consumption
- Consider operation with no external TF for FRC formation test.
- Implement full feedback control
- Detailed measurements using edge probe, MSE, Fast Camera to understand flux closure mechanisms

    - Conduct divertor heat load studies
    - Routine EFIT and TSC